Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils
ASTM D-2850

Lab Manager Approval _____ QA/QC Manager Approval _____

1.0 PURPOSE AND SCOPE

This procedure describes methods, materials, equipment, and special conditions required to determine the strength and stress-strain relationships of a cylindrical specimen of either undisturbed or remolded cohesive soil. This test method provides for the measurement of the total stresses applied to the specimen, that is, the stresses are not corrected for pore-water pressure.

2.0 EQUIPMENT

2.1 Axial Loading Device - This device will have sufficient capacity and control to provide the rate of loading prescribed in the procedure. The rate of advance of the loading device should not deviate by more than ±5% from the selected value.
2.2 Axial Load-Measuring Device – This is an electronic load cell, hydraulic load cell capable of measuring the axial load to an accuracy of 1% of the axial load at failure.
2.3 Triaxial Compression Chamber – This shall consist of a top plate and a baseplate separated by a cylinder. The cylinder may be constructed of any material capable of withstanding the applied pressure.
2.4 Axial Load Piston – The piston passing through the top of the chamber and its seal must be designed so the variation in axial load due to friction does not exceed 0.1% of the axial load at failure as measured in 8.4.1.3 and so there is negligible lateral bending of the piston during loading.
2.5 Pressure Control Device – This device shall be capable of applying and controlling the chamber pressure to with ±2 kPa (0.25 psi) for pressures less than 200 kPa(28 psi) and to within ±1% for pressures greater than 200 kPa (28 psi).
2.6 Specimen Cap and Base – An impermeable rigid cap and base shall be used to prevent drainage of the specimen. It shall be constructed of a noncorrosive impermeable material, and each shall have a circular plane surface of contact with the specimen and a circular cross section.
2.7 Deformation Indicator – The vertical deformation of the specimen shall be measured with an accuracy of at least 0.03% of the specimen height. The indicator shall have a range of at least 20% of the height of the specimen.
2.8 Rubber Membrane – The rubber membrane used to encase the specimen shall provide reliable protection against leakage.
2.9 Sample Extruder – This shall be capable of extruding the soil core from the sampling tube in the same direction of travel which the sample entered the tube and with minimum disturbance of the sample.
2.10 Calipers – Calipers are used to measure the height and diameter of the specimen shall be capable of measuring to 0.001.
2.11 Timer
2.12 Balances

3.0 REAGENT

3.1 No regents are used with this procedure.

4.0 DEFINITIONS

4.1 TEST ENVIRONMENT: A fairly constant temperature of approximately 20°C during analysis.

5.0 DOCUMENTATION

5.1 Form F211: Undrained, Unconsolidated Triaxial Compression

6.0 PROCEDURE

6.1 Specimen Size – Specimens shall be cylindrical. The height-to-diameter ratio shall be between 2 and 2.5. The largest particle size shall be smaller than one-sixth the specimen diameter. If, after completion of a test, it is found based on visual observation that oversize particles are present, indicate this information in the report of test data.

6.2 Undisturbed Specimens – Specimens obtained by tube sampling may be tested without trimming except for cutting the end surfaces plane and perpendicular to the longitudinal axis of the specimen, provided soil characteristics are such that no significant disturbance results from sampling. Handle specimens carefully to minimize disturbance, changes in cross section, or change in water content. Where removal of pebbles or crumbling resulting from trimming causes voids on the surface of the specimen, carefully fill the voids with remolded soil obtained from the trimmings. Determine the mass and dimensions of the specimen using the devices described. A minimum of three height measurements (120˚ apart) and at least three diameter measurements at the quarter points of the height shall be made to determine the average height and diameter of the specimen.

6.3 Compacted Specimens – Compacted specimens may be prepared by compacting material in at leas six layers using a mold of circular cross section having dimensions meeting the requirements enumerated in 6.1. The top of each layer shall be sacrificed prior to the addition of material for the next layer. The tamper used to compact the material shall have diameter equal to or less than one half the diameter of the mold. After a specimen is formed, remove the mold and determine the mass and dimensions of the specimen.

6.4 Place a latex seal on the lower platen, and then place the specimen on the base. Next place a latex seal on top of the specimen followed by the top platen. Place the membrane on the membrane expander and place it over the specimen. Seal the membrane to the top and base using o-rings.

6.5 With the specimen encased in the rubber membrane, assemble the triaxial chamber. Bring the axial load piston into contact with the specimen cap several times to permit proper seating and alignment of the piston with the cap. During this procedure, take care not to apply an axial stress to the specimen.

6.6 Start the test with the piston slightly above the specimen cap, and before the piston comes in contact with the specimen cap, zero the axial load-measuring device to compensate for the friction and thrust.

6.7 Apply the axial load to produce axial strain at a rate of approximately 1%/min for plastic materials and 0.3%/min for brittle materials that achieve maximum deviator stress at approximately 3 to 6” strain At these rates, the elapsed time to reach maximum deviator stress will be approximately 15 to 20 minutes. Continue the loading to 15% axial strain, except loading may be stopped when the deviator stress has peaked then dropped 20% or the axial strain has reached 5% beyond the strain at which the peak in deviator stress occurred.

6.8 Record load and deformation values at about 0.1, 0.2, 0.3, 0.4, and 0.5% strain; then at increments of about 0.5% strain to 3% and, thereafter at every 1%. Take sufficient readings to define the stress-strain curve; hence, more frequent readings may be required in the early stages of the test and as failure is approached.

6.9 After completion of the test, remove the test specimen from the chamber. Determine the water content of the test specimen in accordance with Test Method D-2216 using the entire specimen, if possible.

6.10 Prior to placing the specimen (or portion thereof) in the oven to dry, sketch a picture or take a photograph of the specimen showing the mode of failure (shear plane, bulging, etc.).

6.11 Clean work station when work is finished. Initial and date data sheet.

7.0 CALCULATIONS

7.1 Calculate the axial strain, *e* (expressed as a decimal), for a given applied axial load, as follows:

$$e = \Delta H/H_0$$

where:
ΔH = change in height of specimen as read from deformation indicator, and
H_0 = initial height of test specimen minus any change in length prior to loading.

7.2 Calculate the average cross-sectional area, A, for a given applied axial load as follows:

$$A = A_0/(1-e)$$

Where:
A_0 = initial average cross-sectional area of the specimen, and
e = axial strain for the given axial load (expressed as a decimal).

7.3 Calculate the principal stress difference (deviator stress), $\sigma_1 - \sigma_3$, for a given applied axial load as follows:

$$\sigma_1 - \sigma_3 = P/A$$

where:
P = measure applied axial load, and
A= corresponding average cross-sectional area.

8.4 Stress-Strain Curve – Prepare a graph showing the relationship between principal stress difference (deviator stress and axial strain, plotting deviator stress as ordinate and axial strain (in percent as abscissa. Select the compressing strength and axial strain at failure.

8.0 SAFETY

8.1 Lab wear including a lab coat, goggles, and gloves should be worn at all times.
8.2 Keep workstation clean at all times. Wipe any spills to avoid safety hazards.

9.0 CORRECTIVE ACTION

9.1 Notify laboratory manager of any discrepancies.

10.0 REFERENCES

The following ASTM methods have been referenced for this procedure:
D-422, D-653, D-854, D-2166, D-4318, D-2850